U. S. DEPARTMENT OF COMMERCE
CIVIL AERONAUTICS ADMINISTRATION
WASHINGTON 25, D. C.

TECHNICAL STANDARD ORDER

Regulations of the Administrator

Part 514

SUBJECT: AIRCRAFT FLIGHT DIRECTOR TSO-C52

Part 514—Technical Standard Orders for Aircraft Materials, Parts, Processes, and Appliances

Under section 601 of the Civil Aeronautics Act of 1938 and the delegation of authority from the Civil Aeronautics Board in §3.18, 4a.31, 4b.18, 6.18, and 7.18 of the Civil Air Regulations, the Administrator of Civil Aeronautics is authorized to adopt performance standards and specifications of materials, parts, processes, and appliances used in aircraft as he may find necessary to implement the provisions of the Civil Air Regulations. The Administrator adopted the Technical Standard Order system as a means to carry out this delegated authority. This system, in brief, provides for CAA-industry cooperation in the development of performance standards and specifications which are adopted by the Administrator as Technical Standard Orders, and a form of self-regulation by industry in demonstrating compliance with these orders.

Part 514 of the Regulations of the Administrator contains two subparts. Subpart A contains the general requirements applicable to all Technical Standard Orders, such as "Method of Conformance," "Marking," and "Deviations." The provisions of Subpart A are repeated below for the convenient reference of the public. Subpart B contains the technical standards and specifications to which a particular product must conform. In accordance with the foregoing format the standards and specifications of the subject Technical Standard Order are set forth in the appropriate section of Subpart B. TECHNICAL STANDARD ORDERS MAY BE OBTAINED BY SENDING A REQUEST TO CAA, WASHINGTON 25, D. C.

SUBPART A—GENERAL

§514.1 *Basis and purpose*—(a) *Basis.* Section 601 of the Civil Aeronautics Act of 1938, as amended, and §§3.18, 4a.31, 4b.18, 6.18, 7.18 of the Civil Air Regulations.

(b) *Purpose.* The purpose of this part is to establish minimum performance standards for aircraft materials, parts, processes, and appliances which are to be used on civil aircraft of the United States, and to prescribe the manner by which the manufacturer must show compliance with such performance standards.

§514.2 *Method of conformance.* A manufacturer of an aircraft material, part, process, or appliance for which standards are established in Subpart B of this part, prior to distribution for use on a civil aircraft of the United States, shall furnish a written statement of conformance certifying that the material, part, process, or appliance meets the applicable performance standards established in this part. The statement of conformance shall be signed by a person duly authorized by the manufacturer, and shall be furnished to the Chief, Aircraft Engineering Division, Office of Flight Operations and Airworthiness, Civil Aeronautics Administration, Washington 25, D. C.

If complaints of nonconformance with the requirements of this Order are brought to the attention of the CAA and investigation indicates that such complaints are justified, the Administrator will take appropriate action to restrict the use of the product in civil aircraft.

§514.3 *Marking.* Materials, parts, processes, and appliances for which a statement of conformance has been submitted, shall be legibly and permanently marked with the following information:

(a) Name and address of the manufacturer responsible for compliance,

(b) Equipment name, or type or model designation,

(c) Weight to the nearest pound and fraction thereof,

(d) Serial number and/or date of manufacture, and

(e) Applicable Technical Standard Order (TSO) number.

§514.4 *Deviations.* No deviation will be granted from the performance standards established in Subpart B. Requests for deviation from other requirements of this part should be addressed to the Aircraft Engineering Division, Office of Flight Operations and Airworthiness, Civil Aeronautics Administration, Washington 25, D. C.

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§514.51 Aircraft flight director--TSO-C52--(a) Applicability--(1) Minimum performance standards. Minimum performance standards are hereby established for aircraft flight director instruments which specifically are required to be approved for use in civil aircraft of the United States. Aircraft flight director instruments to be eligible for installation in civil aircraft shall meet the standards set forth in SAE Aeronautical Standard AS-420, "Flight Directors", dated December 15, 1954.1/

(b) Data requirements. One copy each of the manufacturer's operating instructions, schematic diagrams, and installation procedures shall be furnished the Chief, Aircraft Engineering Division, Civil Aeronautics Administration, Washington 25, D. C., with the statement of conformance.

(c) Effective date. July 15, 1958.

1/Copies may be obtained from the Society of Automotive Engineers, Inc., 485 Lexington Avenue, New York 17, New York.

Society of Automotive Engineers, Inc.
29 West 39th Street
New York City

AERONAUTICAL STANDARD AS 420

FLIGHT DIRECTORS

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Revised

1. PURPOSE: To specify minimum requirements for Flight Directors for use in aircraft, the operation of which may subject the equipment to the environmental conditions specified in Section 3.3.

2. SCOPE: This Aeronautical Standard covers Flight Directors for use on aircraft to indicate to the Pilot, by visual means, the correct control application for the operation of an aircraft in accordance with a pre-selected flight plan.

3. GENERAL REQUIREMENTS:

3.1 Material and Workmanship:

3.1.1 Materials: Materials shall be of a quality which experience and/or tests have demonstrated to be suitable and dependable for aircraft instruments.

3.1.2 Workmanship: Workmanship shall be consistent with high-grade aircraft instrument manufacturing practice.

3.2 Identification: The following information shall be legibly and permanently marked on each of the major components or attached thereto:

a. Name of the unit and type of Flight Director.

b. SAE Aeronautical Standard AS-420.

c. Manufacturer's part number.

d. Manufacturer's serial number or date of manufacture.

e. Manufacturer's name and/or trade mark.

f. Rating (electrical power supply - if required).

3.3 Environmental Conditions: The following conditions have been established as design criteria only. Tests shall be conducted as specified in Sections 5, 6 and 7.

3.3.1 Temperature: When installed in accordance with the instrument manufacturer's instructions, the instruments shall function over the range of ambient temperatures shown in Column A below, and shall not be adversely affected by exposure to the temperatures shown in Column B below:

Instrument Location	A	B
Powerplant Accessory Compartment	-30 to 130 C	-65 to 130 C
Heated Areas (Temperature Controlled)	-30 to 50 C	-65 to 70 C
Unheated Areas (Temperature Uncontrolled)	-55 to 70 C	-65 to 70 C

3.3.2 Humidity: All units shall function and shall not be adversely affected when exposed to any relative humidity in the range from 0 to 95% at a temperature of approximately 32C.

3.3.3 Altitude: All units shall function and shall not be adversely affected when subjected to a pressure and temperature range equivalent to -1000 feet to +40,000 feet standard altitude, except as limited by application of Section 3.3.1.

3.3.4 Vibration: When installed in accordance with the manufacturer's instructions, the units shall function and shall not be adversely affected when subjected to vibrations of the following characteristics:

Type of Component Mounting	Cycles Per Minute	Max. Double Amplitude	Maximum Acceleration
Airframe Structure-Mounted	300-30,000	.050"	10 g.
Shock-Mounted Panel	300-3000	.020"	1.5 g.
Powerplant-Mounted	300-30,000	.100"	20 g.

3.4 Radio Interference: The instrument shall not be the source of objectionable interference under operating conditions at any frequencies used on aircraft, either by radiation or feedback, in electronic equipment installed in the same aircraft as the instrument.

4. DETAIL REQUIREMENTS:

4.1 Indication:

4.1.1 Flight Director Indicator:

4.1.1.1 Steering Control Indication: A steering pointer shall be provided which moves right and left of a zero reference. Departure of the steering pointer from the zero reference shall result from any one, or any combination, of the following signals required to indicate correct control application:

a. Displacement of the aircraft heading to the right of the pre-set heading shall deflect the pointer to the left of the zero reference.

b. Displacement of the aircraft in roll to the right shall deflect the pointer to the left of the zero reference.

c. Displacement of the aircraft to the right of a radio course line shall deflect the pointer to the left of the zero reference.

4.1.1.2 Pitch Control Indication: A pitch control pointer shall be provided which moves above and below a zero reference. Displacement of the aircraft about the pitch axis shall deflect the pointer with respect to the zero reference to indicate pitch angle displacement.

Provisions shall be made for combining the aircraft pitch displacement signal and the glide slope displacement signal in such a manner that a direct indication of correct control application is provided to seek and maintain flight along the glide path. When altitude control is provided in the equipment, pitch displacement and altitude displacement shall be combined in such a manner that a direct indication of correct control application is provided for constant altitude flight.

4.2 Heading Selector: Means shall be provided to permit setting the desired magnetic heading into the Flight Director System. Indication of the heading selected shall be continuously provided.

4.3 Manual Pitch Knob: Means shall be provided for manually setting the pitch control pointer to zero reference during climbs and descent such that a true indication is thus provided of correct control application to seek and maintain flight at the desired pitch angle. This manual setting feature may be ineffective during approach and constant altitude modes of operation.

4.4 Function Selector(s): Means shall be provided for selecting the operational mode (as applicable) for the Flight Director such as:

a. Flight Instrument

b. Radio Course

c. Approach (ILS)

d. Altitude Control

4.5 Attitude Limiter: Provision shall be made to limit the control indications so that pre-set maximum values of bank and pitch shall not be exceeded.

4.6 Safety Provisions:

4.6.1 Interlock Provisions: Provisions shall be made to prevent simultaneous application of approach and constant altitude control.

4.6.2 Power Indication: Unless incorporated in the instrument, means shall be provided to permit the use of a device to indicate whether the Flight Director is receiving power. The indication shall be readily visible under currently accepted aircraft lighting.

4.6.3 Reliability: The Flight Director design shall be such as to preclude (insofar as possible) any hazardous maneuver resulting from malfunction unless an indicating means is provided to warn against such malfunction.

4.7 Power Variations: All units shall function with +15% variation in DC voltage and/or +10% variation in AC voltage and frequency, provided the AC voltage and frequency vary in the same direction.

5. TEST CONDITIONS:

5.1 Atmospheric Conditions: Unless otherwise specified, all tests required by this Aeronautical Standard shall be conducted at an atmospheric pressure of approximately 29.92 inches of mercury and at an ambient temperature of approximately 25C. When tests are conducted with the atmospheric pressure or the temperature substantially different from these values, allowance shall be made for the variation from the specified conditions.

5.2 Vibration:

5.2.1 Vibration to Minimize Friction: Unless otherwise specified, all tests for performance may be conducted with the instrument subjected to a vibration of 0.002 to 0.005 inch double amplitude at a frequency of 1500 to 2000 cycles per minute. The term double amplitude as used herein indicates the total displacement from positive maximum to negative maximum.

5.3 Vibration Equipment: Vibration equipment shall be used which will provide frequencies and amplitudes consistent with the requirements of Section 3.3.4 with the following characteristics:

5.3.1 Linear Motion Vibration: Vibration equipment for airframe structure-mounted or powerplant-mounted instruments or equipment shall be such as to allow vibration to be applied along each of three mutually perpendicular axes of the test specimen.

5.3.2 Circular Motion Vibration: Vibration equipment for shock mounted panel instruments shall be such that a point on the instrument case will describe, in a plane inclined 45° to the horizontal plane, a circle, the diameter of which is equal to the double amplitude specified.

5.4 Power Conditions: Unless otherwise specified, all tests shall be conducted at the power rating recommended by the manufacturer.

5.5 Position: Unless otherwise specified, all tests shall be conducted with the units mounted in their normal operating position.

6. INDIVIDUAL PERFORMANCE TESTS: All of the various units or complete system shall be tested in accordance with the manufacturer's recommendations. The manufacturer shall conduct sufficient tests to prove compliance with this Aeronautical Standard, including the following requirements, where applicable:

6.1 Dielectric: The insulation resistance shall not be less than 5 megohms.

7. QUALIFICATION TESTS: As many instruments or components as deemed necessary to demonstrate that all instruments will comply with the requirements of this section shall be tested in accordance with the manufacturer's recommendations.

7.1 Low Temperature Operation: Each component, or the complete system, after having been subjected to an ambient temperature of -30C or -55C as applicable (see Paragraph 3.3.1), for a period of five hours, without operating, shall then meet the requirements of Section 6 at that temperature.

7.2 High Temperature: The requirements of Section 7.1 shall apply except that the exposure temperature shall be 50C, 70C or 130C, as applicable (see Par. 3.3.1).

7.3 Extreme Temperature Exposure: The system or units shall, after alternate exposure to ambient temperatures of -65C and 70C, or -65C and 130C, as applicable (see paragraph 3.3.1), for a period of twenty-four hours each, and a delay of three hours at room temperature (25°C) following completion of the exposure, meet the requirements of Section 6. There shall be no evidence of damage as a result of exposure to the extreme temperature specified herein.

7.4 Magnetic Effect: Magnetic effect of the function selector and all indicators shall be determined in terms of the deflection of a free magnet approximately 1½ inches long, in a magnetic field with a horizontal intensity of 0.18 (+.01) gauss when the units are held in various positions on an east-west line five inches from the center of the magnet. The maximum deflection of the magnet shall not exceed five degrees. Tests shall be made with instruments in power-on condition.

7.5 Humidity: The instrument shall be operated in its normal operating position in a chamber and maintained at a temperature of 70, +2°C, and a relative humidity of 95, +5% for a period of 6 hours. After this period the heat shall be shut off and the instrument shall be allowed to cool for a period of 18 hours in this atmosphere, in which the humidity rises to 100% as the temperature decreases to not more than 38C. This complete cycle shall be conducted:

a. Five times for instruments located in uncontrolled temperature areas.

b. Once for instruments located in controlled temperature areas.

There shall be no evidence of damage or corrosion following this test which would adversely affect the performance of the system or the units thereof.

7.6 Vibration: The units, while operating, shall be subjected to vibration of all frequencies within the appropriate range specified in Section 3.3.4, in order to determine if there exist any natural frequencies of any parts that lie within the specified range. The amplitude used may be any convenient value that does not exceed the maximum double amplitude specified in Section 3.3.4, and such as not to exceed the maximum acceleration specified in Section 3.3.4. The units shall then be subjected to vibration at the appropriate maximum double amplitude or maximum acceleration specified in Section 3.3.4, at each of the above determined natural frequencies for a period of three hours. If no natural frequencies occurred in the appropriate frequency range, the appropriate frequency and amplitude for the three hour endurance test shall be determined from the following table:

	Cycles Per Minute	Double Amplitude
Airframe Structure-Mounted	3300	.050"
Shock-Mounted Panel	3000	.010"
Powerplant-Mounted	9000	.018"

While the indicator(s) unit is being vibrated, the pointer oscillation shall not exceed the limits outlined below:

a. For pointers which are pivoted at one end, the oscillation shall not be more than 1° travel and its average position shall not be more than 1° from its position before vibration.

b. For pointers which have parallel motion, the pointer shall not oscillate more than .030" total travel and the average position shall not vary more than .030" from its position before vibration.

c. For pointers which are pivoted at the center, the oscillation shall not be more than 1.5° total travel, and its average position shall not be more than 1.5° from its position before vibration.

No screws or other parts shall become loosened as a result of this test.

The instrument shall meet the requirements of Section 6.